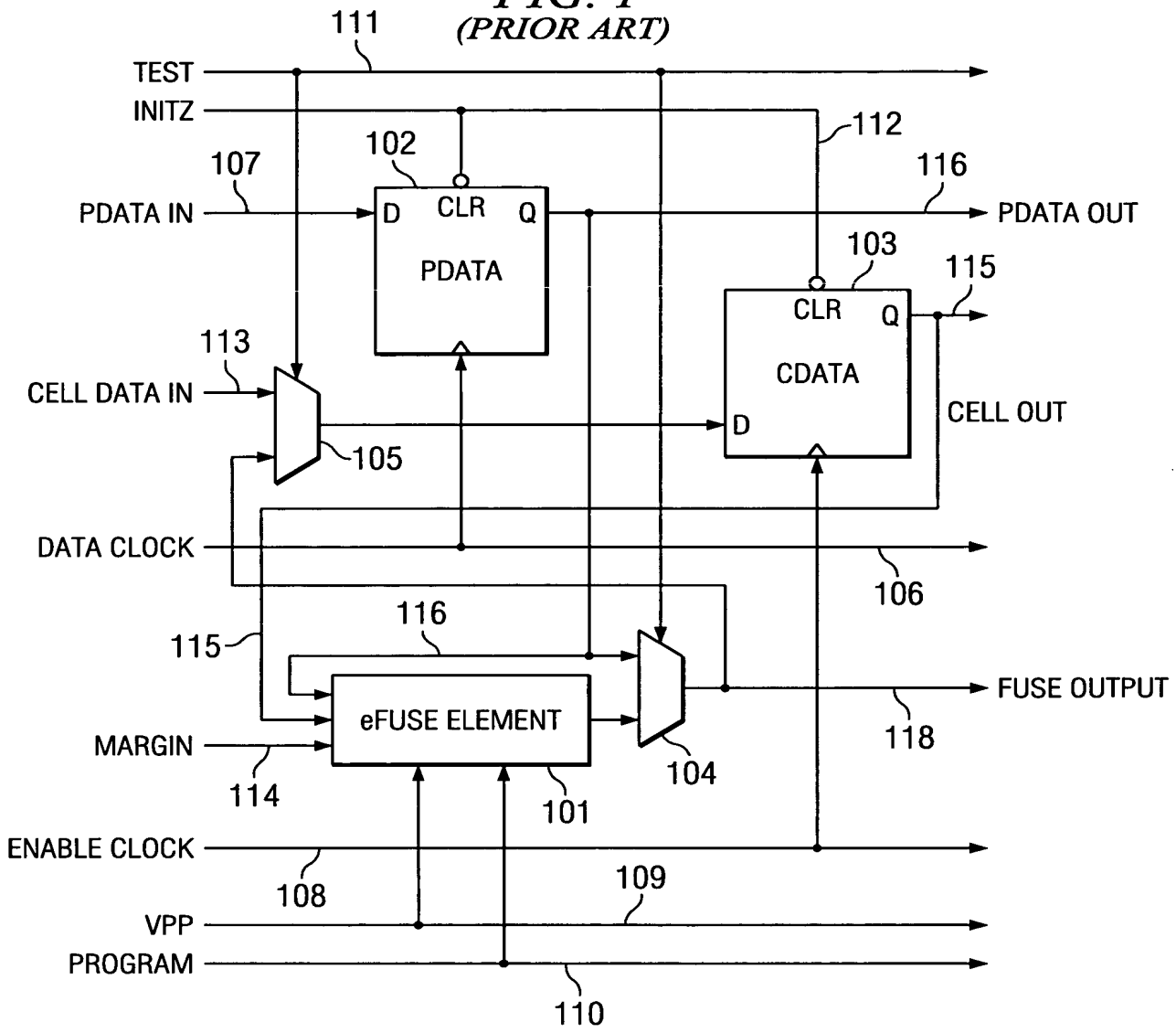
FIG. 1
(PRIOR ART)



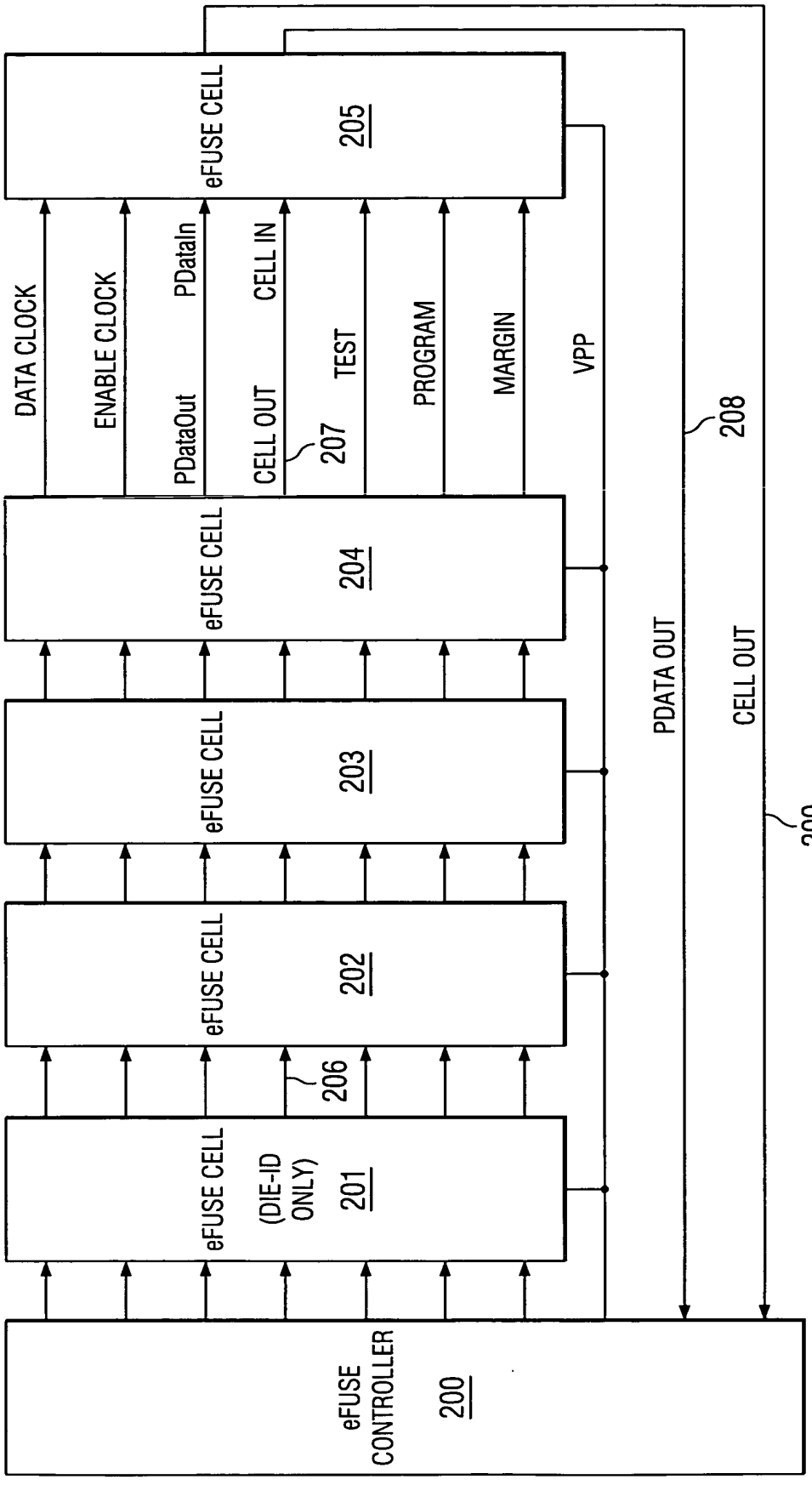


FIG. 2
(PRIOR ART)

FIG. 3

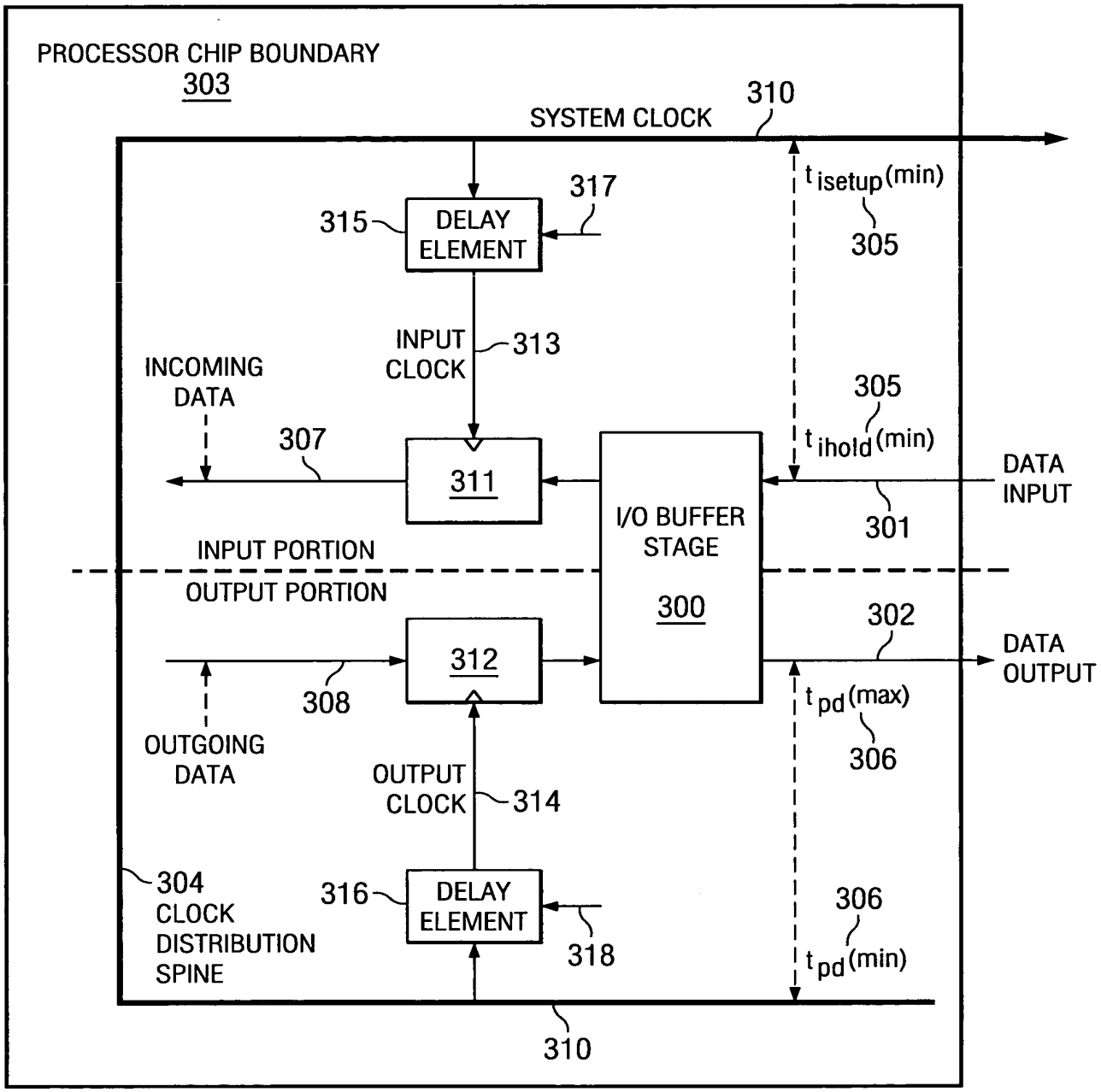

PROCESSOR CHIP BOUNDARY
303
SYSTEM CLOCK
310
317
315
DELAY ELEMENT
t_{isetup}(min)
305
INPUT CLOCK
313
INCOMING DATA
307
311
305
t_{ihold}(min)
I/O BUFFER STAGE
300
DATA INPUT
301
INPUT PORTION
OUTPUT PORTION
302
312
DATA OUTPUT
308
t_{pd}(max)
306
OUTGOING DATA
OUTPUT CLOCK
314
304
CLOCK DISTRIBUTION SPINE
316
DELAY ELEMENT
318
306
t_{pd}(min)
310

FIG. 4

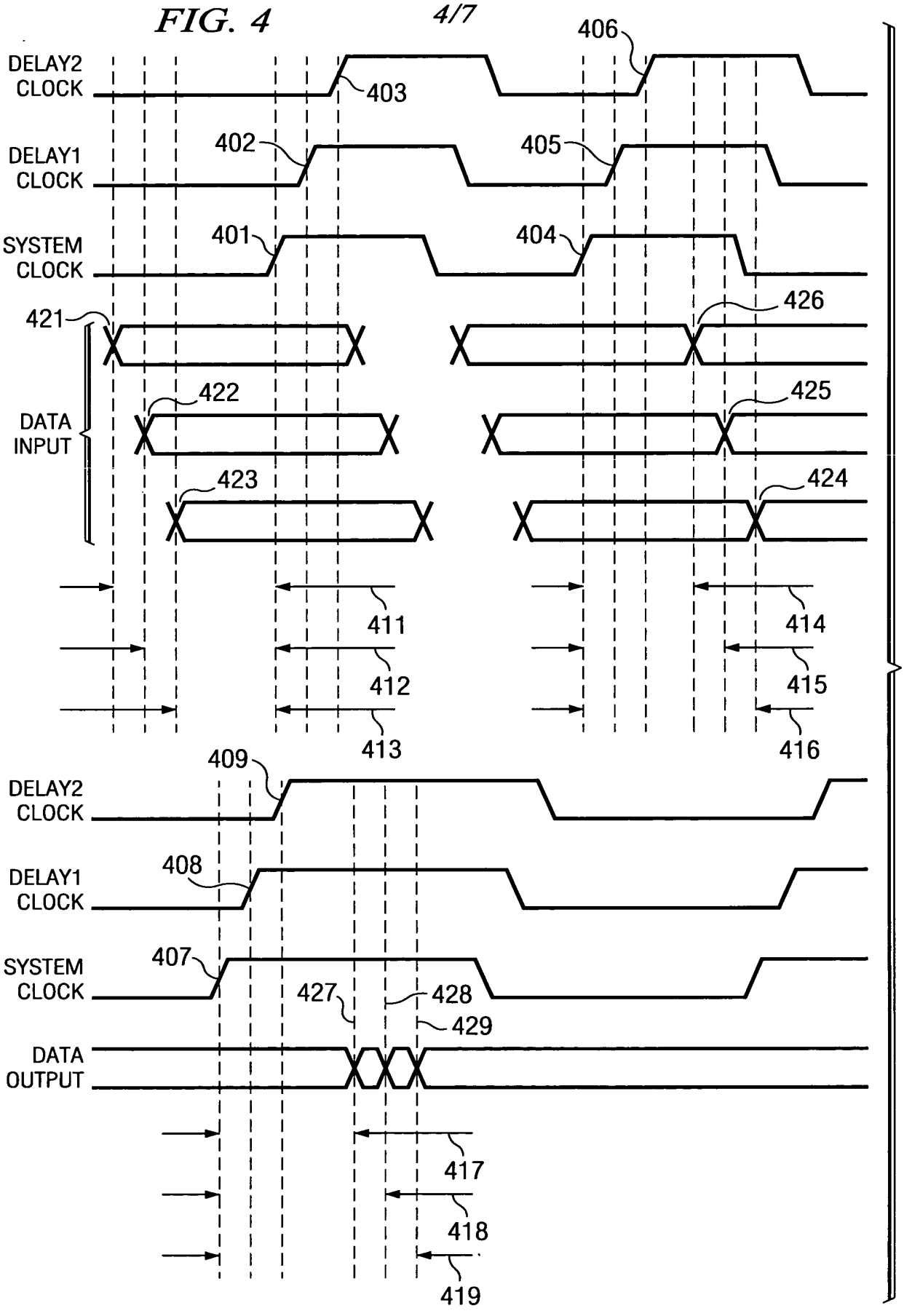

DELAY2 CLOCK
403
406
DELAY1 CLOCK
402
405
SYSTEM CLOCK
401
404
421
426
DATA INPUT
422
425
423
424
411
414
412
415
413
416
409
DELAY2 CLOCK
408
DELAY1 CLOCK
407
SYSTEM CLOCK
427
428
429
DATA OUTPUT
417
418
419

FIG. 5

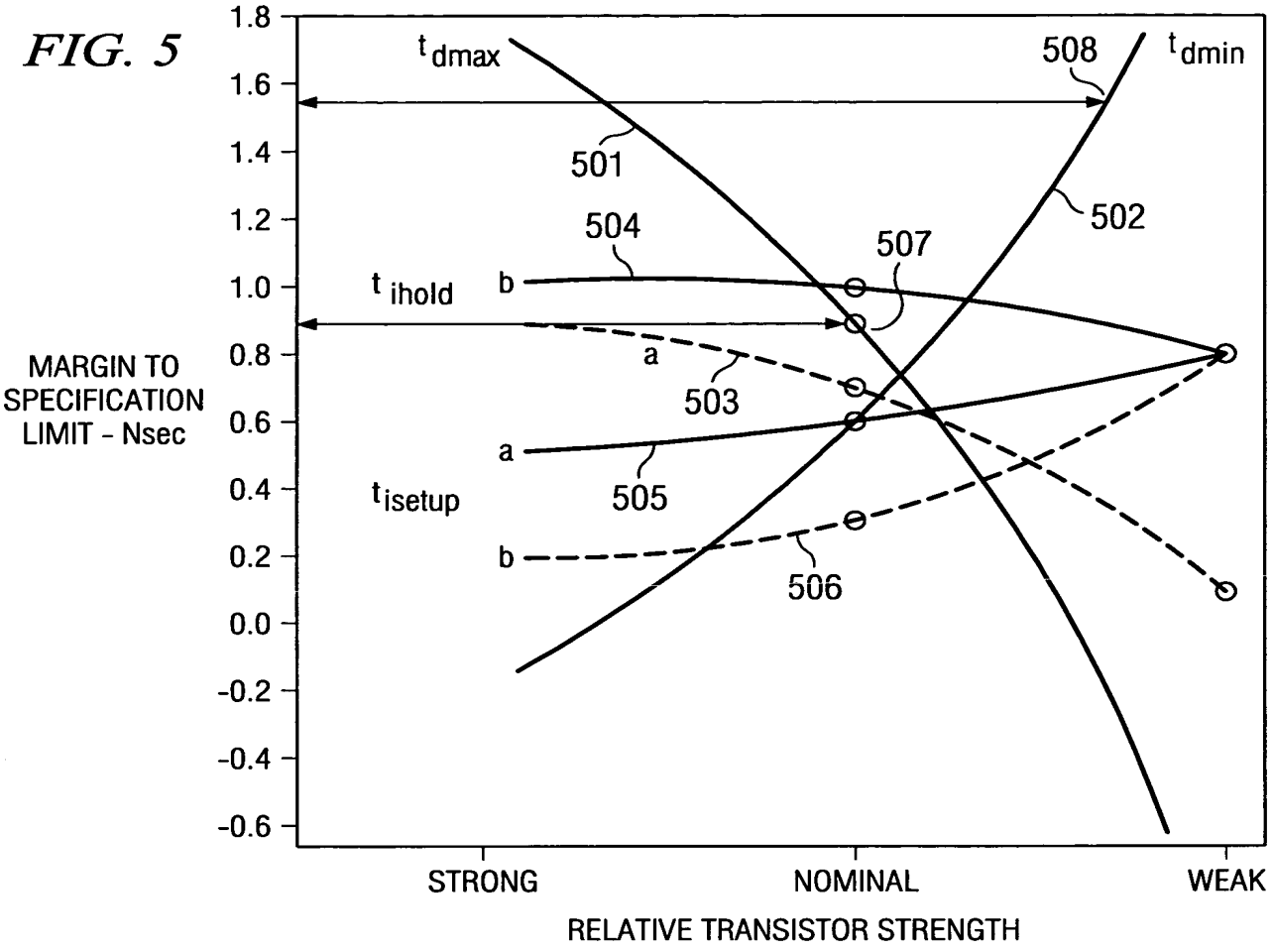
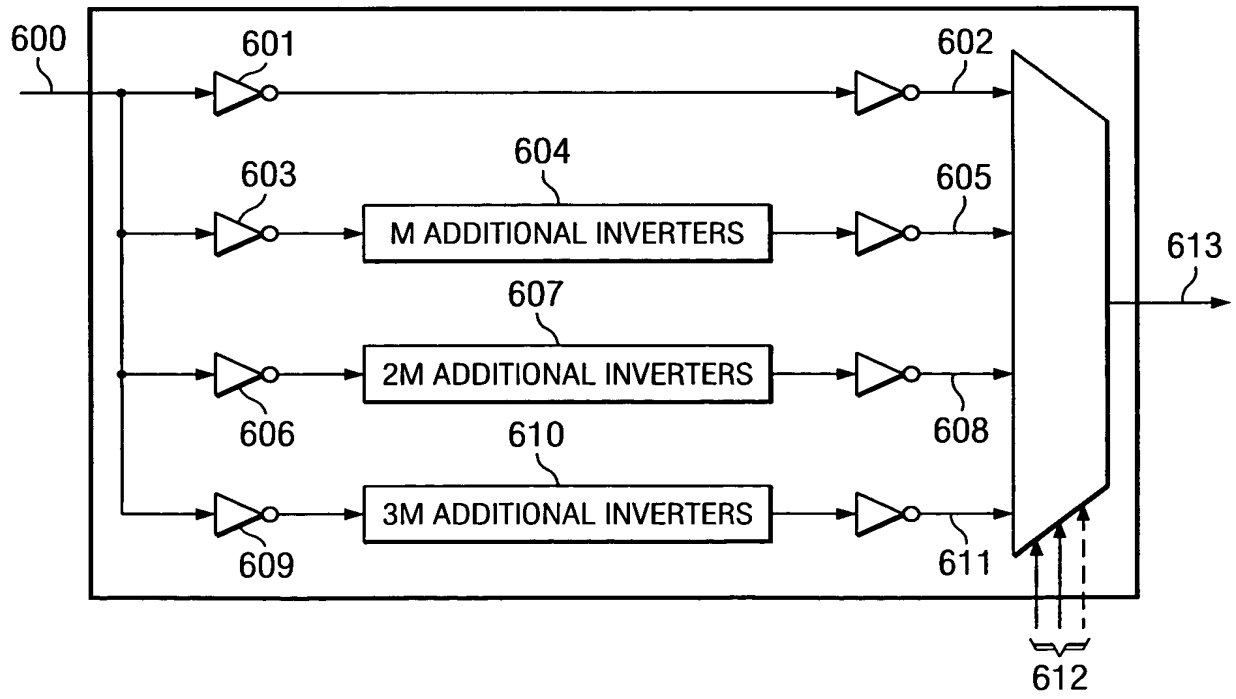

1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
MARGIN TO SPECIFICATION LIMIT - Nsec
t dmax
t dmin
508
501
502
504
507
t ihold
b
a
503
a
505
t isetup
b
506
STRONG
NOMINAL
WEAK
RELATIVE TRANSISTOR STRENGTH

FIG. 6


600
601
602
603
604
M ADDITIONAL INVERTERS
605
613
607
2M ADDITIONAL INVERTERS
606
608
610
3M ADDITIONAL INVERTERS
609
611
612

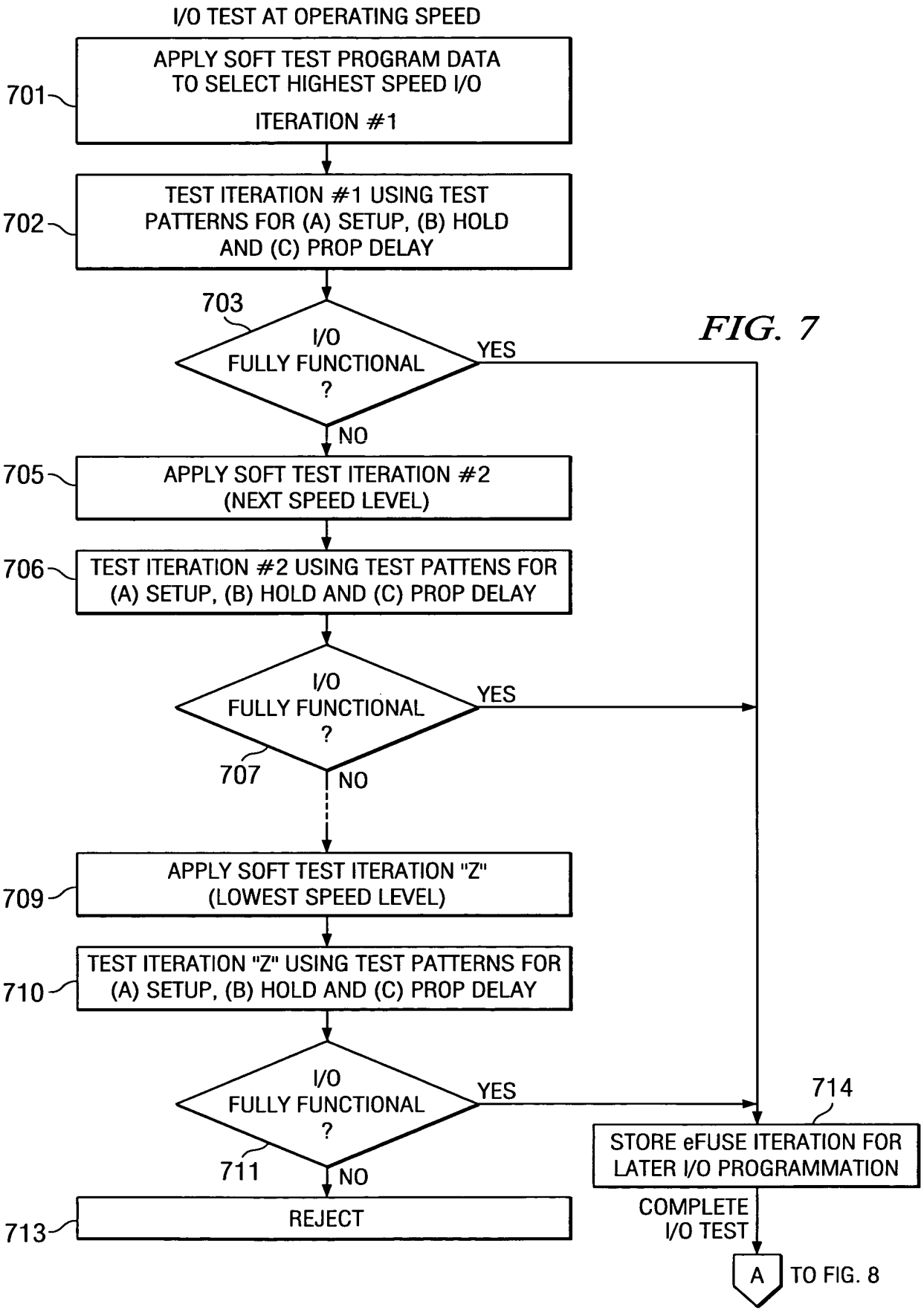
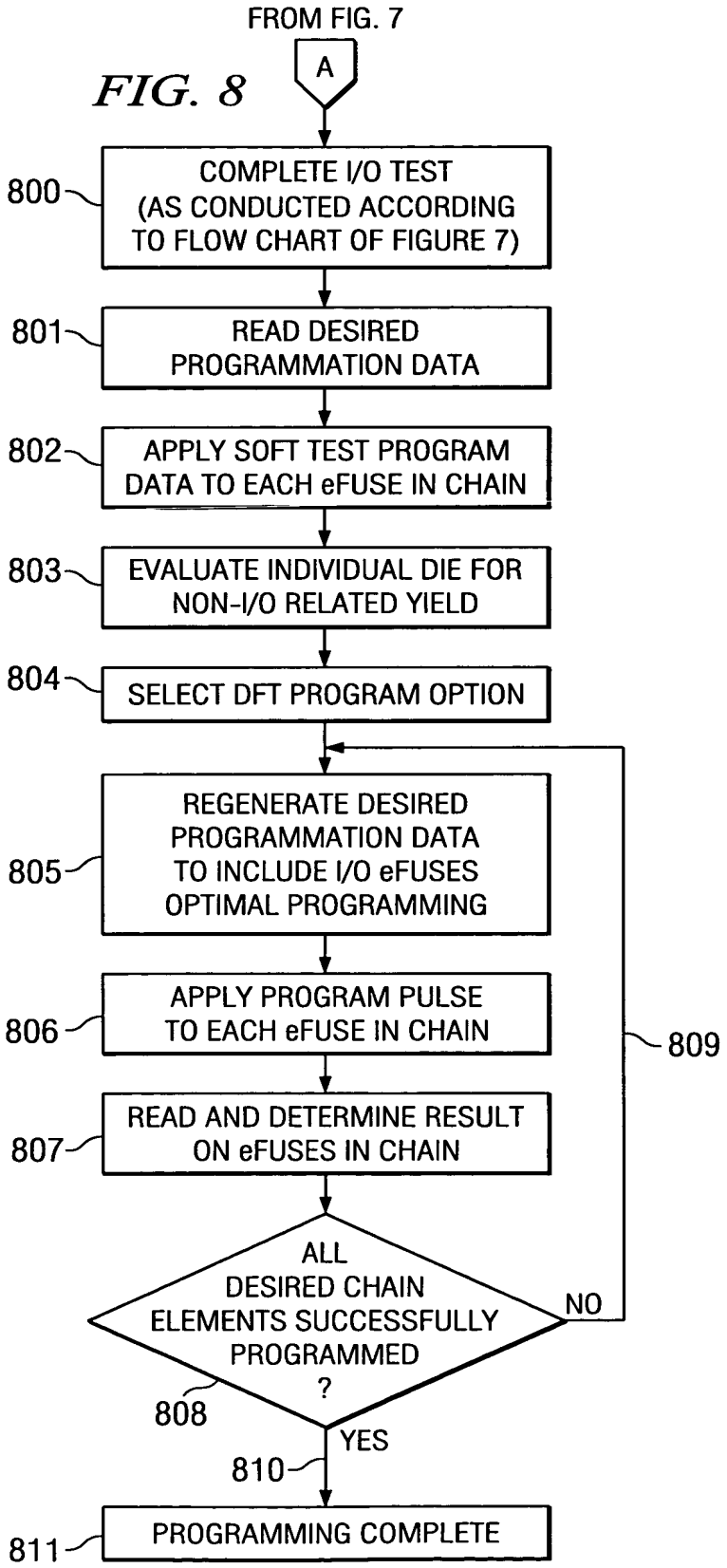

I/O TEST AT OPERATING SPEED
APPLY SOFT TEST PROGRAM DATA TO SELECT HIGHEST SPEED I/O ITERATION #1
701
TEST ITERATION #1 USING TEST PATTERNS FOR (A) SETUP, (B) HOLD AND (C) PROP DELAY
702
703
I/O FULLY FUNCTIONAL ?
YES
NO
APPLY SOFT TEST ITERATION #2 (NEXT SPEED LEVEL)
705
TEST ITERATION #2 USING TEST PATTENS FOR (A) SETUP, (B) HOLD AND (C) PROP DELAY
706
I/O FULLY FUNCTIONAL ?
YES
707
NO
APPLY SOFT TEST ITERATION "Z" (LOWEST SPEED LEVEL)
709
TEST ITERATION "Z" USING TEST PATTERNS FOR (A) SETUP, (B) HOLD AND (C) PROP DELAY
710
I/O FULLY FUNCTIONAL ?
YES
711
NO
REJECT
713
714
STORE eFUSE ITERATION FOR LATER I/O PROGRAMMATION
COMPLETE I/O TEST
A
TO FIG. 8

FIG. 7

FIG. 8


FROM FIG. 7
A
800
COMPLETE I/O TEST (AS CONDUCTED ACCORDING TO FLOW CHART OF FIGURE 7)
801
READ DESIRED PROGRAMMATION DATA
802
APPLY SOFT TEST PROGRAM DATA TO EACH eFUSE IN CHAIN
803
EVALUATE INDIVIDUAL DIE FOR NON-I/O RELATED YIELD
804
SELECT DFT PROGRAM OPTION
805
REGENERATE DESIRED PROGRAMMATION DATA TO INCLUDE I/O eFUSES OPTIMAL PROGRAMMING
806
APPLY PROGRAM PULSE TO EACH eFUSE IN CHAIN
807
READ AND DETERMINE RESULT ON eFUSES IN CHAIN
ALL DESIRED CHAIN ELEMENTS SUCCESSFULLY PROGRAMMED ?
808
NO
809
YES
810
811
PROGRAMMING COMPLETE